# The Chemical Age

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## The Laboratory

THERE is a delightful and perfectly true story of a chemist who was heard to complain to a friend of the multiplicity of his duties. " Whenever they get an unusual job and can find no one of sufficient intelligence to undertake it," he said, " they push it into the laboratory." That is not true of all firms, and it is not true of all laboratories, but it is true of the majority of small laboratories. The chemist in such circumstances is usually a man of no little importance; it is only too true that he may not receive a salary commensurate with his importance, but his importance is nevertheless unassailable. He is too often expected to do his work with home-made apparatus tied together by wire, rubber and even string, with professional appliances of the most hackneyed and the simplest character. We recall the laboratory of a well-known firm specialising in high-temperature work that possessed no instrument capable of measuring a temperature above 600° C. until the coming of the Excess Profits Duty, seconded by a certain amount of low cunning on the part of the chief chemist, enabled a thermocouple outfit to be purchased. Doubtless that story could be capped with many another. The moral is that those strange mortals who in Becker's oft-quoted description are impelled by an almost insane impulse to take their pleasures among smoke and vapour, soot and flame, poison and poverty, should be provided adequately with the appliances needed for the prosecution of their craft. The labourer is worthy of his tools.

While many ill-found laboratories exist, there are also many magnificent ones. The Universities generally set a high standard in this respect, a standard perhaps too high for many of their students who are later compelled to work in less sumptuous surroundings, into which they fit with an ill grace and with no little difficulty. It was perhaps from the difficulty of adaptation to the makeshift surroundings of the industrial laboratory that the belief arose that academic chemists were not worth their salt. Unquestionably the best chemists will always have a high proportion of inventiveness and imagination in their make-up. The progress of research and the development of great research laboratories is changing the outlook towards the laboratory; yet it is still true that first-class work on certain lines can be done with improvised apparatus. It is still true that, as R. E. Bowman has recently pointed out, " Chemistry is not an aristocratic science; its patron saint is Faraday, who began as a lab.-boy "; but in more and more branches of scientific work makeshift apparatus cannot be successfully used. Equipment of a high order of accuracy and sensitiveness is essential if the necessary measurements are to be made. Vast sums of money that would otherwise be squandered in unsuccessful large-scale experiments may depend upon the accuracy of the laboratory results. It is worth while spending a few tens of pounds in order that the thousands required later may be spent to good advantage. It is a curious perversity of the business man that he too often regards expenditure upon the laboratory as money wasted, under the mistaken idea that the chemist is an expense and not an investment.

Laboratory furnishing firms have to-day achieved a singularly high standard of perfection in apparatus. Those who remember the conditions of laboratory equipment during the last war will be grateful for the strides that have been made to produce high-class glassware and scientific apparatus in this country. We began to realise quite early in the last war how great had been our dependence upon foreign laboratory equipment, and to understand how much our war effort at that time was handicapped in consequence. The glass-makers and the glass-blowers, aided manfully by those cunning in the working of metals and in other fine arts, rose to the occasion, and before the war ended we were producing apparatus and glassware that was equal, if not superior, to the German and Austrian product. This time we have learnt our lesson, and neither in respect to apparatus nor to the chemicals which that apparatus assists us to produce are we handicapped. War, like peace, is a scientific struggle. To every weapon that is invented by one side the other must produce an answer or perish; it is in the laboratory that the answer must be sought. It was through laboratory researches that the answer was given to the magnetic mine. It was in the laboratory that poison gases were devised; it was in the laboratory that the antidotes to those gases were discovered. Medical science and the practice of medicine no less than medical research depend upon scientific apparatus. The making of laboratory apparatus may seem to be but a minor industry, but it provides the means for the genesis of great industries, and for the putting in train of great events that mould human destiny.

During the Abyssinian difficulties a well-known Italian, Signor Marinetto, gave a list of typically British qualities. These, he said, comprised " tea-drinking, snobbery, golf-playing, puritanism, clean-shaveness, pipe-smoking, bridge-playing and inexplicable apathy towards women." Until the last war he might have added " distrust of scientific methods and scientific apparatus "; it took a great war to eradicate that, but to-day science and the means whereby it is pursued rank high in our estimation.

# A MAJESTIC EFFORT

SIR JOHN SIMON'S War Budget is a majestic effort which will assuredly impress the world with the determination of the British people to make every conceivable sacrifice to carry the present struggle to a victorious end. If the sum total of the national expenditure is colossal, the burden which the present generation is cheerfully taking on its shoulders is unique in British history. The figure of £1,234,000,000, which the Chancellor of the Exchequer seeks to get from revenue this year, contains a larger amount drawn from taxation than has ever before been raised in a similar period in the history of British finance. There remains the even larger figure of £1,433,000,000 to be raised by loan, and that was the central question posed in the Budget speech. That gap, too, will be bridged in the normal way by a continuance of the appeal, which will undoubtedly be successful, for voluntary withdrawals from the savings of the public. No part of Sir John Simon's speech gave greater satisfaction in financial and commercial circles than his refusal to touch with a barge-pole Mr. J. M. Keynes's plan for a forced loan.

It can be affirmed straight away that the industrial and commercial community welcomes the main structure of the Budget plan as bold, statesmanlike and a testimony, not only to the courage of the British people, but to the essential soundness of its finance. How wisely the foundations were laid was revealed in the decision not to increase income-tax beyond the figure of 7s. 6d. in the pound announced in the emergency Budget last autumn. It would have been a mistake to add further to the direct burdens on business, which have been increased by roughly 50 per cent. in the last two or three years, and there could be no quarrel with Sir John Simon if, on this occasion, he confined his attention to the indirect taxpayer. He skilfully avoided the imposition of any further burdens on food or any other article indispensable to the mass of the people, with one exception. The drinker of beer and spirits and the tobacco smoker, whom he actually asked for a much heavier contribution than before, can look after themselves and continue or restrict their consumption of what are clearly not necessities, as their purse allows. The House of Commons made no bones about accepting these proposals, and only jibbed when Sir John Simon announced an all-round increase of Post Office charges and an entirely new tax.

These two proposals were likewise not viewed with equanimity by the business world. Its attitude is similar to that disclosed by a large part of the House of Commons that they need further reflection and almost certainly modification after free debate. The proposal to add no less than a penny to the present letter rate of three-halfpence threatens a serious blow at every business in the country. The new rate is actually a halfpenny more than the maximum necessitated by the last war, and when there is added a 15 per cent. rise in telephone rates, the increased burden on tax-producing business seems excessive. There is widespread agreement with the dictum of *The Times* that "a first and very strong impression is that these changes in postal and telephone rates for the sake of adding £12,500,000 to the revenue are not worth it."

The proposed Purchase Tax must also be a target for informed criticism. Sir John Simon only outlined it in the most general terms, leaving the machinery, and even the amount to be levied, to be revealed later. He did, however, make it clear that it is not to be a tax on luxuries as such, but a tax on sales, to be charged by wholesalers to retailers. The difficulty of framing an equitable sales tax is shown by the widespread exceptions which had immediately to be announced. Not only are articles of food and drink to be excepted, but the tax is not to be applied to goods manufactured for export or to articles already heavily taxed, such as tobacco and petrol. Sir John Simon put forward this novelty as deliberately aimed to discourage expenditure at home, but fancy schemes of this nature have never fitted in well with the orthodox canons of British finance. For the purpose of financing as well as fighting the war, every branch of British industry and commerce should be at full stretch, and any artificial restriction on enterprise may have a very different result from that anticipated by the Chancellor's academic advisers. Fortunately, in the case of the Purchase Tax with no date fixed for its imposition, there is time for its various implications to be thoroughly examined before Parliament is called upon either to accept or reject it.

Other proposals affecting industry and commerce were perhaps to be expected, and will not arouse serious controversy. The Government intends to prohibit the distribution of profits by bonus shares by public companies, and to limit dividends on ordinary shares to the largest distributed in any one of three pre-war years. Such provisions would not be tolerated in normal times, but can possibly be justified at the height of a great war by Sir John Simon's argument that increased profits should be available to sustain industry or to repair it in the period of post-war adjustment.

Still, when every qualification has been made, the Budget of 1940 must be regarded as a fine achievement. In essentials it is accepted already, and Sir John Simon will have only the most loyal co-operation from the public in providing the sinews of war for those gallant men at sea, in the air and on land whose offer of sacrifice far transcends that of the most heavily burdened taxpayer at home.

## New Control Orders

### Mercury and Mercurial Compounds

IN consequence of advances in the price of mercury since the previous Order was issued, the maximum prices of certain mercury compounds have been revised by the Ministry of Supply under the Control of Mercury (No. 4) Order, 1940, which came into force on April 19.

Copies of the new Order may be purchased from H.M. Stationery Office, and inquiries should be addressed to the Ministry of Supply (Code HA), Raw Materials Department (Mercury Control), Shell-Mex House, Strand, London, W.C.2.

### Chromium and Chromium Compounds

Some misapprehension appears to exist as to the effect of the Control of Chrome, Magnesite and Wolfram (No. 1) Order, 1940, Direction No. 1 on the schemes of distribution of bichromates and their derivatives which are at present operated by the Ministry of Supply. It is not the intention that the Order, with its formal requirements of licences, etc., should be applied to these materials which, thanks to the co-operation of manufacturers and consumers, have been successfully brought within the voluntary schemes; and for this reason the Direction No. 1 issued under the Order altogether exempts them for the time being from the licensing arrangements. It is the desire of the Ministry that the voluntary schemes of control should remain in force; but it will be appreciated that their continuance is mainly dependent on the ready co-operation of all in the trades affected by them.

### Exemption from K.I.D.

The Treasury has made an Order under Section 10 (5) of the Finance Act, 1926, as amended by Section 2 (1) of the Import Duties (Emergency Provisions) Act, 1939, exempting phenol (synthetic) from Key Industry duty from April 19 until June 30, 1940. Copies of the Treasury Order, which is entitled "The Safeguarding of Industries (Exemption) No. 6 Order, 1940," may be obtained from H.M. Stationery Office.

# CHEMICAL MICROSCOPY TO-DAY

## Applications in Many Branches of Chemical Industry

by CECIL L. WILSON, M.Sc., Ph.D., A.I.C.

WHEN a new branch of science first makes its appearance, one of two things may happen to it, quite regardless of its merits. It may become the topic of conversation of the day with the scientists in whose particular field it lies, attracting a plethora of workers to its development. Or it may remain almost untalked of and unheard of for many years, only kept alive by the few who feel an acute interest in it, and because of its own intrinsic worth. Such a contrast can be found in the field of microchemistry. In 1894 Behrens published a textbook which has been the foundation stone of most of the subsequent work in what we now know as chemical microscopy[1]; while even earlier, Boricky, Lehmann, Haushofer and others were pioneering in the same field[2 3 4 5 6], although their work is less well known. About 1911 Pregl began his classic researches[7] leading to the development of organic quantitative microanalysis. The position of these two branches to-day is worth some consideration.

The proportion of published research dealing with chemical microscopy is relatively scantier than that in the newer field; and the author has talked with chemists of no little standing who have used the term "microchemistry" as if it were synonymous with "organic quantitative microanalysis." To these people, chemical microscopy appeared to be practically unknown, or, at best, a freak development of chemistry, rather than a powerful branch with applications to almost every phase of the science. It is difficult to place one's finger on the reason for this indifference towards chemical microscopy. There is apparently a reluctance among chemists to use the microscope, or to trust its findings when used. This must, no doubt, be in large part blamed on the academic training of chemists who, unless they have studied biology, are frequently almost completely ignorant of how to use a microscope after they have had a university training. That this is so is supported by the fact that in industry, where there is the highest percentage of non-academically trained chemists, there also appears to be the widest use of the microscope. But that this is not the whole reason is probable, since it is in industry that the advantages of microscopical methods are most obvious. The question of cost much also be considered, but this is simplified by the fact, unfortunately not generally realised, that the most expensive microscope is often not the best instrument for chemical purposes. And it does not excuse the frequent purchase of a microbalance, where a microscope would be a more profitable investment.

### The Importance of the Microscope

It was only after writing the above that the author found, in an early textbook on the microscope[8], this quotation of Chamot: "It is rather remarkable how slow American chemists have been in realising the importance of the microscope as an adjunct to every chemical laboratory. This is perhaps largely due to the fact that few of our students in chemistry become familiar with the construction and manipulation of the instrument, just as few of them become sufficiently familiar with the spectroscope and its manifold uses: and doubtless also because of the prevailing impression that a microscope is primarily an instrument for the biologist, and is of necessity an expensive luxury. The fact is, however, that this instrument is now far from being a luxury to the chemist, and soon it will be conceded to be as much a necessity in every analytical laboratory as is the balance."

That every chemist should nowadays have a working knowledge of the microscope, and a realisation of its potentialities as a research instrument is an ideal which we in Great Britain are still far from realising. As a contrast, in America at least one University has a chair of Chemical Microscopy, and summer courses in the subject are frequent. It is to be deplored that such an important experimental aid should have its genesis in Germany, and flourish in America, while making so little impression in this country. And it is to be hoped that the time is not far distant when we shall no longer treat the microscope as the ugly duckling of chemical apparatus. All chemists should realise that there is something wrong with the method which applies to the microscope as a last resort, when it should so often be the first court of appeal. It was in this hope that the author felt impelled to begin, in a rather complaining manner, what was intended merely to be a review of chemical microscopy in the past few years.

For the newcomer to the subject, numerous introductions exist.[9-20] Of these must be picked out for special mention the invaluable work of Chamot and Mason[9] which should be in every library with any pretensions to chemical completeness. For chemical microscopists the publication of a second edition of the first volume of this classic[21] is another milestone in the progress of the science. While the additions to it may not merit what is undoubtedly a heavy outlay for anyone already in possession of the first edition, it is essential to become acquainted with them, particularly the valuable section on the extension of measurement and quantitative methods in microscopy. A briefer introduction to the subject by the same authors, but one which is as full as possible within thirty pages, has also appeared recently.[22] This gives an adequate number of references to the literature elsewhere.

### Investigations in Many Directions

Although, as the author hopes to show later, chemical microscopy does not consist merely of examining crystals under the microscope, this is an important part of its functions. It is therefore of interest to find that some systematic investigation has been carried out on the constancy of the appearance of crystals of any one substance under the microscope,[23] with results reassuring for the chemical microscopist. At this point might also be mentioned the cognate investigation of the alteration induced in crystalline form by the presence of foreign material. It has been known for some time[24] that when sodium chloride is crystallised in the presence of urea its form is altered through the suppression of certain faces. Likewise (*ibid*) methylene blue and picric acid are selectively adsorbed by lead nitrate crystal faces. These facts seem to be related to the discovery by Lindsley[25] that precipitation of barium sulphate in the presence of picric acid so alters the physical form that reproducible crystalline nature, observable under the microscope, is conferred on what is normally a so-called amorphous precipitate. This is necessarily of immense importance from such points of view as the filtration of such material in gravimetric analyses. It is also in the nature of a warning against the imprudent use of chemical microscopy without due control of conditions.

The field of inorganic qualitative analysis by chemical microscopy may be divided roughly into three parts. Firstly, there is the development of so-called "specific" or "selective" reagents, which will give characteristic precipitates with one or a few ions only, in the presence of a large number of others. In this way, tests have been developed for antimony and bismuth,[26], zinc,[27] palladium,[28] cadmium,[29] lead[30] and rubidium,[31] to name only a few. It is a pity that too often such reagents are not sufficiently tested from the point of view of interference before their use is published. As a consequence, there is now an unco-ordinated mass of literature which is almost unproductive. It consists of an indistinguishable collection of tests, many of which are almost useless because they are interfered with by practically everything, while others which may be invaluable do not appear to be so, and are therefore neglected. Two of the

tests mentioned above, those for lead and for rubidium, are worthy of further consideration because of interesting points which they raise. That for lead recommends a valuable procedure in the electrolytic deposition and concentration of the lead before application of the test, thus making it even more sensitive. In the test for rubidium the extinction angle of the crystals formed is noted. It is a pity that this is not a more general practice, for the constant in many cases is easy to determine, and may be a decisive factor in the recognition of the crystal forms.

The second section of this branch may be described as the development or discovery of more general reagents, which

**Model B Petrological Microscope No. 3950, by R. & J. Beck.**

may be used for the identification of several ions. The best known example of a reagent of this type is probably ammonium (or potassium) mercuric thiocyanate,[32] of which further mention will be made. Other examples, investigated more recently, are anthranilic acid as a reagent for several cations,[33] and certain salts of complex cations such as hexamminocobaltic chloride, for use in identifying anions.[34 35 36] It is essential that such reagents should be fully investigated to determine the effect of coprecipitation of several ions on the limits of detection for these ions. Such an investigation has been fully carried out for ammonium mercuric thiocyanate[37] and will prove of infinite use in the application of this reagent.

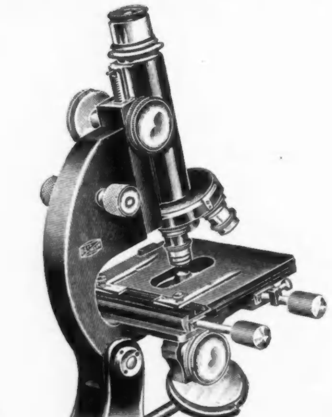
Thirdly, one must consider those cases where systematic analysis is being applied. Two methods may be evolved. The ions may be divided into largish groups within which crystal tests are specific. This is now simple in the case of analytical group I.[38 39] Alternatively, further separations may be carried out, as is the general rule in macroanalysis.

Here the author feels impelled to voice another complaint. The use of spot tests in microchemical qualitative analysis is admirable. But it can be carried to extremes, and there is a very evident tendency that way at present, so that frequently analysts will prefer a poor or a difficult spot test to a satisfactory crystal test. As a result, in many of the analytical schemes published, spot tests are used exclusively for final identification. There is even sometimes the suspicion of a boast that the authors have succeeded in "dispensing with the use of microscopes." The present author feels that this attitude is fundamentally as unsound as the endeavour to use crystal tests only for the same purpose. It is imperative that in the preparation of such a scheme careful thought should be given to both types of test when they are available, and the best chosen irrespective of the branch to which it belongs. This has been admirably done in the scheme of Benedetti-Pichler and his co-workers, which has been appearing for some time past.[10]

Before leaving the field of inorganic qualitative analysis, reference must be made to the necessity for further tables of such physical properties as can be determined under the microscope. Extensive tables of this nature exist,[41 42] but the need is more particularly noticeable for the newer type of inorganic organic compound which is resulting from the increased use of organic reagents for analysis.

The microscrope, compound and polarising, is finding increased use in organic qualitative analysis.[43 44] Once again, the work of Behrens[14] laid the foundation for this type of work. While Behrens was mainly concerned with identification reactions, it is obvious that preliminary work must be carried out such as is described by Alber,[45] and in the series of papers by Schneider and Foulke.[46] After the class of compound has been identified by some such means, tests which will distinguish between the different compounds of one class are required, and these are being developed along the lines of the longer known use of dimedone and 2:4-dinitrophenylhydrazine[47] for aldehydes and ketones. To instance some of these, *p*-xenyl semicarbazide[48] and barbituric acid[49] have been recommended to identify aldehydes; $\beta$-naphthazide and $\beta$-naphthyl isocyanate[50] are suggested as reagents for the identification of phenols; alkyl halides, amines, carboxylic acids,[51] hydroxy acids,[52] sulphonic acids[53 54] and amino acids[55 56] have all had the microscopy of certain of their derivatives studied. In the case of the amino acids, the use of refractive index to distinguish between derivatives of the same crystal habit is of interest.

A number of specific reactions has been reported, although these are naturally few. It should be remembered that such a reaction may prove to be reciprocally useful, as in the case of the test described by Denigés for anthracene.[57] Here the reagent is bromine dissolved in chloroform, and the test may be used equally well for bromine, by concentrating this element in chloroform, and testing with anthracene.[58] Direct examination of the crystal form of the unknown, crystallised from various solvents, has been the method applied by Quense and Dehn to the sugars.[59] Their results would show that in a field for which sufficient data exist this method will probably be of great use. One important organic group, that of the



**No. 29M London Microscope, by R. & J. Beck.**

alkaloids, has been studied systematically,[60 61] and a scheme for the separation and identification of twenty alkaloids has been devised. This scheme is suitable for detecting milligram quantities of each alkaloid, preferably if not more than three of these are present in the mixture. The need for tables of optical properties of organic compounds is also urgent, since these are even more sparse than in the inorganic field. Finally, an interesting development is foreshadowed by the *quantitative* estimation of a disulphonic acid precipitated as the barium salt.[62] The author of this method claims an accuracy of $\pm 0.5$ per cent. for his procedure.

That the microscope has great possibilities for physico-

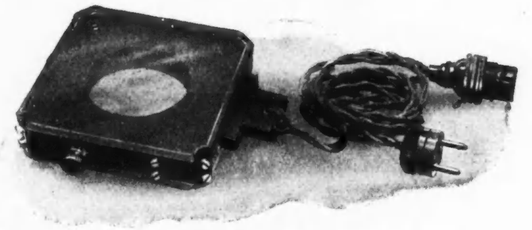
chemical methods has been recognised from the earliest days of its application to chemistry. The determinations of melting point and refractive index are well known. The former of these has been dealt with in some detail, together with sublimation methods, in a small book by Kofler, Kofler and Mayrhofer.[63] Several other writers have also described improved apparatus for hot stage work with the microscope.[64 65 66] This has been extended not only to the investigation of ordinary melting points, but also to the study, with the polarising microscope, of the melting points and natures of polymorphous modifications in a large number of organic compounds.[67]

Refractive index methods have been bettered mainly from the point of view of the liquids used for the immersion method.[69] Kunz and Spulnik[70] have recommended that, where such standard liquids are mixtures, their components should have as nearly as possible the same vapour pressures, so that alteration of composition on standing may be avoided. One modification[71] of the normal type of cell used for measurement by apparent and real depths has been suggested.

The microscope as an instrument for density measurements by striations[72] and for measurement of molecular weight by Barger's method[73] is widely known and used. Although difficulties are bound to arise in the development of methods suitable for further physico-chemical measurements, one interesting method for determining surface tension has been described comparatively recently, and does not appear to be well known.[74] A notable application of the microscope is in the determination of relative humidities.[75] A series of salts with known "deliquescing vapour pressures" is used. By observation of tiny crystals of these salts under the microscope, the vapour pressures of solutions in whose atmosphere they are placed can be determined by the changing appearance of the salts.

The great development of chromatographic adsorption in recent years has resulted in considerable progress in the field of fluorescent microscopy. The fact that both primary fluorescence, and secondary fluorescence induced by "fluorochromes" are possible has allowed considerable extension of the applications of the microscope to fluorescence problems, and of fluorescence to chemical problems in general. In addition to the more usual applications to such things as food and drugs, fibres, minerals and synthetic compounds, described by Haitinger,[76 77] Frosch and Hauser[78] have shown that in such important problems as types of emulsions, flotation, penetration into porous materials, and wood preservation the use of colourless dyes of high fluorescing power is very valuable.

One of the outstanding characteristics of the microscope is that it can often be applied where classical methods might fail completely, or be, at best, very laborious. Two examples of this, which have been quoted elsewhere, might be repeated here to illustrate this. Lithopone has been protographed under the microscope with the aid of ultra-violet light.[79 80] The result is a striking demonstration of its constitution. Cumar gum resin was used as the mountant, and as this is semi-transparent to ultra-violet light, the background of the photograph is grey. Barium sulphate and zinc sulphide are respectively transparent and opaque to ultra-violet light, so that the

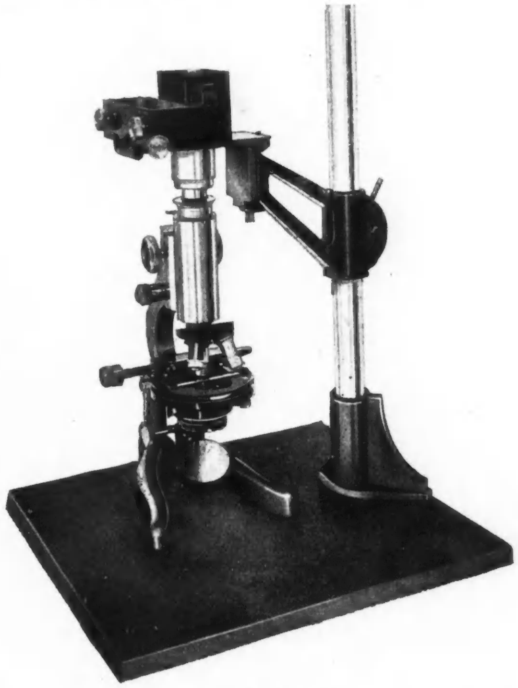


**McLaren electrical hot stage, by W. Watson & Sons.**

former appears on the photographs as white, and the latter as black particles. The other example is the distinction between the sodium or ammonium phosphates,[81 82 83] which, if carried out by quantitative analysis, requires about three days' work, while under the microscope it is a matter of minutes.

It is this ability of the microscope which should, and frequently does, make it of extreme use in industry. Its earliest application, in the field of mineralogy,[84] has been extended in obvious directions to cover industrial dusts.[85 86] Similarly, microscopic examination has become an integral part of many investigations into the structure of cements.[87]

The more recent investigation of emulsions by means of the microscope is instanced in the work of King,[88] who stresses



**Sayce-Watson camera, by W. Watson & Sons, set up for photomicrography.**

the point that size-frequency analysis is the only satisfactory method of studying emulsions quantitatively. A somewhat similar application has been made in the size-distribution measurement of fine powders.[89] Systematic study of soap solutions has been carried out recently by Ekwall,[90] who describes and illustrates the crystalline forms of the free fatty acids, the neutral and the acid soaps.

The identification of organic dyestuffs by sublimation at definite temperatures followed by examination of the resulting crystals for such properties as angles and pleochroism is a normal, but useful enlistment of the aid of the microscope.[91]

The field of artificial resins is also proving the importance of microscopy. Several workers have used the microscope to examine physical properties such as hardness and refractive index, and to investigate flaws.[92 93] They have shown how useful information may be obtained about the various types of filler, such as fibres, minerals, and synthetic chemical substances, which may be present. The search for flaws has also resulted in the development of a grinding and etching technique by Gottwald and Weitzel, which is followed by treatment over fifteen-minute periods with boiling water, or by exposure to chemical action. For fibres the polarising microscope is known to be an essential instrument, as it is also for the examination of foods, drugs, inorganic constituents in plant tissues, and chemical production control. Another application to an industrial problem is the analysis of minute foreign bodies which may be removed from the general mass under a binocular microscope. This is exemplified in the analysis of coloured and crystalline specks in soap.[94]

To complete this article, several of the more outstanding novel developments in the use of the microscope will be dealt

with briefly. The discovery by Land and Friedman in 1930 that certain organic materials, when allowed to crystallise, were capable of polarising light, has given the opportunity for replacement of the Nicols in microscopes by a much cheaper substitute, which is not limited in size. Substances such as iodoquinine sulphate and iodocinchonine sulphate, suspended in a plastic,[95] are proving effective as polariser and analyser in microscopes for many purposes, and render the adaptation of the ordinary microscopes to a reasonably adequate petrographic or polarising microscope both cheap and easy. In the same way, several papers have suggested the use of Cellophane as an adequate substitute for other more expensive compensating devices, since Cellophane of "300" thickness has a retardation of about 1/3 wavelength.[96 97]

A survey of chemical microscopy would not be complete without special mention of the field opened up by Benedetti-Pichler in the handling and analysis of microgram samples. Just as alteration from gram to milligram work requires a new technique, so the alteration from milligram to microgram ($\mu$g.) work necessitates new apparatus and methods. In his paper[98] Benedetti-Pichler describes how he has developed the technique to deal with such operations as the separation of 0.1$\mu$g. of antimony and 0.01$\mu$g. of bismuth, including a sulphuretted hydrogen precipitation; the recognition of silver as the crystalline chloride is also described. Manipulations are carried out mainly under the low-power microscope, and solutions are transferred by pipettes operated by means of a hypodermic syringe.

Of necessity this summary touches but briefly on a number of the phases of usefulness of chemical microscopy, and omits some entirely. It is hoped, however, that readers of it will be interested by it sufficiently to follow up some of its ramifications. For this reason, a full list of references has been appended, which may serve to supplement the excellent classified lists of references which have appeared from time to time in *Mikrochimica Acta* and in *Mikrochemie*, with which the former has now been amalgamated.

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(*Continued at bottom of p.* 243)

# Modern Trends in Laboratory Planning

## Benching and Lighting Improvements

by C. H. BUTCHER

THE general planning of the laboratory continues in the direction of providing better facilities for the workers. The old type of laboratory in crowded surroundings and bad lighting has gone. Much attention has been devoted to the matter of obtaining good light, for this is now demanded in the deciding technique of analytical work such as the observance of delicate colour changes and examinations under the microscope. Present-day analytical reactions having reached a high state of perfection generally, as well as in utility for detecting and determining very small quantities, it has been the normal consequence of things to expect better conditions of working. Not only the placing of benches in respect of natural daylight been better thought out, but artificial lighting has also shown improvement. Among the very wide range of lighting fitments now made there are some which have been expressly designed for such a situation as the industrial laboratory, where there are special problems to be faced in the lighting of a balance bench or a titration bench.

Laboratory benches and tables seem to have acquired a much greater degree of refinement; they are no longer the cumbersome constructions that once they were. Many are light enough in weight, but still firm and soundly constructed, to allow them to be moved at will to meet some immediate need in the work which is in hand—if services and drainage are not connected. Indeed, even this tends to go further, as service pipes for gas, water, compressed air, etc., are now more generally fixed upon the surface of the walls or taken from a permanent overhead arrangement of pipes, in both cases being much more accessible for maintenance than when concealed beneath the floor and an assembly of benches. Sinks are being better located at convenient points as separate features, and the drainage of water from condensers and the like is carried away by large-bore pipes (to which there are adequate openings) placed alongside the other services.

Benches are now almost entirely built up on the unit principle, so that any combination of facilities can be provided for the needs of different ideas in the planning and running of a laboratory. Cleanliness generally has been enhanced by the absence of superfluous mouldings on the woodwork and by keeping rigidly to square legs, and also by space beneath being easily accessible to the cleaners. Fixed fume cupboards have likewise been refined in construction, and doors may be either vertical-rising or sideways-sliding, with gas and water controlled from without. There is also a tendency to instal benches for certain types of work directly beneath open fume hoods, which in one laboratory of recent completion are made of stainless steel. These hoods offer much convenience, and can be arranged in smaller units to serve benches placed in the centre of a room, because fumes are now more often carried away by fan draught than by a flame in a chimney. The provision of such hoods over part of the benches can do much towards keeping the atmosphere healthy, and the extra expense of providing them is adequately offset by better work on the part of the laboratory staff.

A range of material is now available for bench tops, teak or other woods treated with acid-proof and heat-proof solutions being favoured, with special composition materials such as Technolite or Asbestolite to meet the needs of a titration bench or heat from furnaces on a muffle bench. Glass, or one of the above composition materials, is frequently used in place of wood for bottle shelves. Cupboards are fitted with sliding doors on ball runners in preference to hinges, as there is no inconvenience of a cupboard door being left open with possibility of accident, and greater ease of access to the cupboard is also obtained. Such sliding doors are an advantage if space is restricted, as in small cubicles for individual research workers. For most assemblies of benches adequate knee space is provided between the cupboards that are built flush with the front of the bench.

Bench fittings in the nature of taps and valves are taking on a smarter general appearance and are better placed for convenience of use, being sometimes provided with a stainless finish in place of brass, or gunmetal black-bronzed. Likewise sinks of glazed fireclay or stoneware are giving place to stainless steel and Monel metal.

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# THE BRITISH LABORATORY GLASSWARE INDUSTRY

## Foreign Made Products Superseded

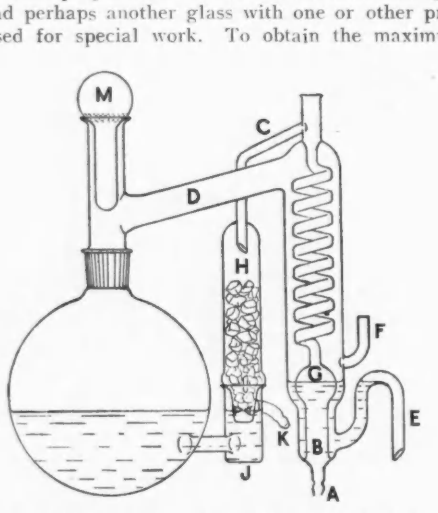
### by NORMAN SHELDON, A.R.C.S. (Lond.)., A.I.C.

THE possession of a well-organised and efficient scientific glassware industry is one of the many advantages with which this country started the present war, as compared with the Great War of 1914-18. This industry is a master key industry without which even the other key industries could scarcely carry on. In 1914 no scientific glassware was made in Great Britain, and it is unnecessary to remind those chemists who had to carry on laboratories in munition factories of the difficulties experienced in obtaining the supplies or of the peculiar forms a flask could take when made by a glassblower who was new to the job!

After the rush of post-war orders was over the industry fell on evil days owing to the sudden renewal of imports from Germany at fantastically low prices. Several firms ceased production and it seemed likely that Germany would recover the whole trade. However, one or two people interested took a second deep breath and set about the task of improving the quality of our glassware and two new firms joined the fight. The result was the firm establishment on the British market of several well known brands of glassware that are in many ways superior to anything ever produced in Germany. A great variety of British glassware is now available for all scientific and engineering purposes.

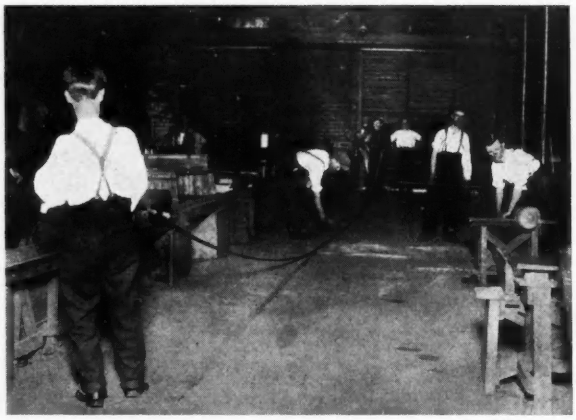
There are three distinct divisions in the industry: glassware blown in moulds at the furnace, glass tubing, and apparatus made at the blowpipe from tubing.

The chief articles that are mould-blown at the furnace are beakers and flasks. This section probably covers 75 per cent. of the trade other than tubing, but there is also a large number of items blown as blanks for graduated glassware or as parts of more complicated apparatus that is mainly lamp-blown. Beakers and flasks are always made in what is known as resistance glass, but this word "resistance" must not be taken to represent anything very definite. The chemist must make up his mind what he wants the glass to resist—it may be acid or alkali or a variety of other chemicals, which all have a different effect upon glass. It may be that resistance to sudden changes of temperature is more important than the highest possible resistance to chemical action. The average laboratory needs a glass that will combine all these properties to a reasonable extent for general work, and perhaps another glass with one or other property emphasised for special work. To obtain the maximum resistance to heat changes it is usually necessary to sacrifice resistance to strong alkaline solutions. The earlier British glasses made during the period 1915-22 were exceptionally good in their resistance to chemical attack but a demand gradually arose for a glass with a better resistance to heat, as this property reduced the risk of breakage in use. It was also found that beakers and flasks of superior heat-resisting qualities could be made much thicker and so gain mechanical strength and reduce the casualties at the hands of the "lab-boy."



The "Bara" glass still unit, made by Baird & Tatlock.

The manufacture of heavy chemical ware such as desiccators, aspirators, Woulff's bottles, etc., was begun in 1915 but, owing to the renewal of German competition after the war, production ceased entirely until about 1930 when John Moncrieff, Ltd., of Perth, were requested by the Board of Trade to develop this section. Heavy chemical ware is usually made of a soft glass than can be easily manipulated by the workman at the furnace and also on account of cost. Chemists should always remember that ordinary articles of heavy chemical ware, whether British or foreign, are not made in resistance glass. If such a glass is needed for special work it should be clearly specified on the order. The British


Hand-drawing glass tubing for laboratory ware in the works of John Moncrieff.

manufacturers in all sections of the trade are always willing to do their best to meet the special needs of the research worker requiring something not available among ordinary stock lines.

The glass tubing section has developed even more than the mould-blown section during recent years owing to the large number of purposes for which tubing is now used. There is a great variety of formulæ used in tubing manufacture ranging from the softest forms of soda tubing, through various grades of neutral or semi-resistance glass, up to the hardest types such as Monax, Hysil and Pyrex, and the hardest combustion tubing sold under the trade mark M.J.V.

An interesting example of a combination of lamp working with mould-blown blanks is shown in the "Bara" glass still unit which is designed to produce, continuously from a tap-water feed, distilled water of higher quality than that produced by any other single glass still.

Enormous quantities of glass tubing are now used for medical purposes, chiefly for various forms of flat-bottomed tubes and ampoules for packing medical supplies. Various colours are used in addition to clear glass. The neon sign

industry also takes large quantities of tubing. A big percentage of the total output of glass tubing is now machine-drawn, but owing to certain limiting factors in the machine-drawn article, there is still a substantial demand for hand-drawn tubing. In fact nearly all the tubing for the more specialised scientific work and for various engineering purposes is hand-drawn. The accompanying illustration shows fairly clearly how this operation is carried out and may help many chemists and engineers to realise why it is so difficult to get a piece of glass tube to an accurate specification. Glass workers think in millimetres and not in the thousandths of an inch to which engineers work when fixing their tolerances. If a piece of glass is to be used in a machine it is always wise to consult the glass-maker before starting the construction of the machine, so that the metal can be made to fit the glass, instead of trying to make glass fit the metal parts.

In making glass tubing the worker first of all gathers a large ball of glass from the furnace and while still hot he works it into a suitable shape with a bubble of air in the middle. Another worker then joins his iron to the other end of the ball and the two men walk apart drawing out the tubing until an assistant armed with a gauge indicates that correct size is reached, and then, while still hot and slightly soft, the glass is laid in the trough to keep it straight while it is cooling. Many years of training are required to achieve the highest skill in this class of work. The production of thermometer tubing for various types of clinical and chemical thermometers is an even more difficult operation owing to the necessity of controlling the size and position of the bore extremely accurately. The method adopted is very similar to that shown in the illustration.

The working of glass tubing in the blowpipe has developed into an industry in itself. An enormous variety of apparatus is now made from glass tubing or a combination of glass tubing with mould-blown blanks. There seems to be no limit to the complexity of the apparatus that can be built up, and the materials used vary from the softest glass to pure silica itself.

### Interchangeable Joints

Some years ago this industry received a great stimulus by the introduction of standard interchangeable ground joints. Until comparatively recently every ground joint was made individually, the two parts being ground together to ensure a fit and then carefully marked so that the pieces would not be mixed with other similar pieces with which they would not fit accurately. This lack of interchangeability limited the use of ground joints because of the difficulty of replacing breakages. If one joint was broken the whole apparatus became useless. Now all this is changed and the British Standard Specification for ground glass joints ensures that not only will joints made by the same firm be interchangeable in any quantity and will hold the highest vacuums, but also that joints made by different firms may be interchanged with each other. It is now unnecessary to buy any apparatus with a joint that is not standard unless some odd size is required. A complicated piece of apparatus can now be built up by simply taking standardised parts and fitting them together; the erection of such apparatus is now as simple as building up a model in Meccano.

The outbreak of war in September last caused an immediate shortage of many articles of chemical glassware which were still imported from Germany owing to the lower costs in that country. British manufacturers were immediately called upon to make up the shortage. This is being done to the best of their ability, but owing to a shortage of skilled labour, delays are bound to occur in some directions.

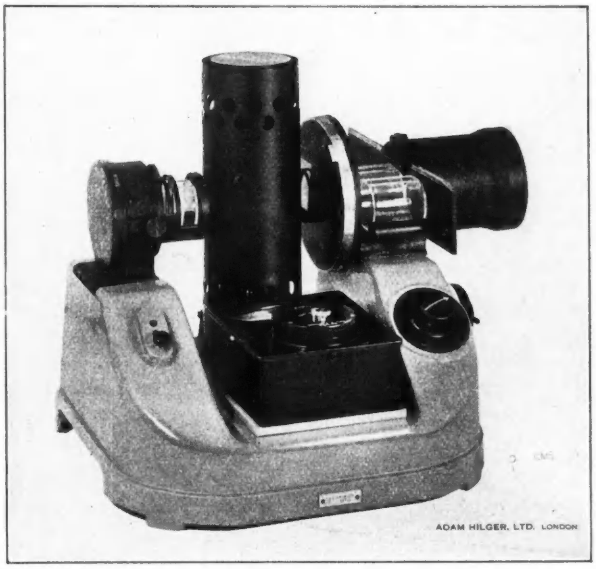
It is interesting to note that yet another German speciality is now becoming available in glass of British manufacture, namely the sintered glass filters. The sintered filters manufactured by the makers of Jena glass had become very popular in laboratories all over the world, and many chemists were greatly handicapped when the supply of these was cut off by war. Several well-known British firms immediately set to work to produce a satisfactory substitute and I am glad to be able to announce that a comprehensive range of funnels, etc., wth sintered glass discs in all the usual grades of porosity will be available very shortly.

## The Spekker Absorptiometer

### Valuable Aid in Colorimetry

THE development of colorimetric methods of analysis has led to the increasing use of photo-electric instruments for this purpose, and the Spekker Absorptiometer, produced by Adam Hilger, ranks high amongst those that are now available for use in the chemical industry. This instrument was placed on the market about four years ago and immediately met with favour in industrial laboratories. It may fairly be described as an "all-purpose" instrument, being of use for colorimetric tests in the analyses of metal contents, for the determination of the *p*H of sugar, milk and flour, for colour tests on water, as well as for biological and pathological tests.

Among the chief features of the instrument may be mentioned: (1) the readings are independent of fluctuations in the mains supply, from which the instrument is run directly;




**The Spekker Photoelectric Absorptiometer, No. H454**

(2) the photo-cells are extremely robust; (3) the readings are not affected by varations in the sensitivity of the cell or of the galvanometer, since a null method is used; (4) readings can be taken with as little as 8 c.c. of liquid; (5) the system is free from the necessity of having a standard solution against which to compare every test solution (as is necessary with visual "colorimeters"). Standard solutions for a given test are prepared and measured on first use of the instrument, and need be repeated only after long intervals.

The standard instrument (H454) is adapted to use cells either 1 or 4 c.ms. in length. For general use the 1 c.m. length is recommended, but for feebly coloured liquids the larger cells are preferable. A special modified form of the instrument (H525) is also available which will take cells up to 20 c.ms. in length. The latest models have lamphouses and fittings of a modified design which allows for the substitution of an electrical sodium discharge lamp for the filament lamp usually supplied. With the monochromatic light thus obtained it is found that Beer's Law is more closely followed.

# RECENT ADVANCES IN SCIENTIFIC APPLIANCES

## No War-Time Check on New Developments

ALTHOUGH war-time conditions have necessitated strenuous work on the part of the makers of laboratory appliances and scientific instruments, they have been quite unable to quell the inventiveness of technical workers. From all parts of the country reports have come in relating to new instruments of all kinds and we are glad to have the opportunity of placing on record the enterprise and resource of British instrument makers.

For example, the Thermal Syndicate, of Wallsend, report that although the extensive occupation of the company with work of national importance does not permit of much development work other than that particularly required to order, yet only a week or two ago they were able to devise a method of producing porous discs of Vitreosil pure fused silica. These can be fused into laboratory apparatus of this well-known acid- and heat-resisting material. In the fields of Vitreosil and Alumina laboratory ware, work is continually proceeding to ensure more rapid production of material of improved quality. The users' needs are always in mind, and when the question of standardising the more commonly used fused silica crucibles and basins was under discussion the manufacturers were very ready to collaborate in the practical work required to prepare the British Standard Specification which has now been issued.

While the heat- and acid-resisting properties of Vitreosil ware are well known readers may be glad of a reminder that the re-crystallised Alumina ware is suitable for use up to 1950° C. and is chemically resistant to many fused metals, oxides, salts, slags and glasses. Some typical examples are shown in the accompanying illustrations.

### Thermostatic Control

In chemistry and physics many tests and measurements have to be carried out at constant temperature, the influence of temperature variations being in many cases larger than that of all the other experimental errors together. It is, however, a well-known fact that temperature is seldom so closely regulated as it should be, not because of ignorance, but because of the troublesome handling and inconvenience of the usual laboratory bath. Sometimes considerable auxiliary apparatus and expenditure of time is necessary to build up the bath from components, which frequently fail at the moment they are most needed. Accuracy of regulation is very often not satisfactory, as the single parts are not designed to work together. On the other hand thermostatic baths of high accuracy are very expensive and not always available, being developed by research workers for their own purposes. It seems, therefore, that chemists and physicists would value a thermostatic tank of high precision and wide range and flexibility.

The Steiner Constant Temperature Equipment, manufactured in this country, has a number of features of interest to industrial and research laboratories. It is not only a self-contained, full-view bath but supplies any other instrument with thermostatically controlled liquid. This is the first equipment designed for such general duties, and we understand that it has taken five years to develop such an instrument. It was first applied to viscosity measurements, the accuracy of which is extremely dependent on close temperature regulation: an inaccuracy of 0.1° C. means often a 2 per cent. error in viscosity. Very precise viscosity measurements have already been published (L. A. Steiner, Compte Rendu, IIe Congrès Mondial de Pétrole, Paris, 1937; L. A. Steiner, Ind. Eng. Chem. Anal. Ed., 1938, *10*, 582) and would have been impossible without close temperature control.

The precision of control up to 160° C. is ±0.01° C. or better and it is obvious that such a precision is only possible by careful design and exhaustive experiments. Once the temperature is set it is maintained automatically for indefinite periods, regardless of fluctuations of room temperature or barometric pressure. The control equipment is installed in the control box, to be seen in the illustration between the container and the circulating pump. A pilot lamp indicates the operation of the heaters, which are controlled by relays commanded by a mercury contact thermometer.

The equipment is usually fitted out with a contact thermometer from 0° to 100° C. Additional contact thermometers and cooling arrangements can be supplied, so that the range is extended from −35° C. to +160° C. = −30° F. to +320° F. The liquid is forced with great velocity along the heating coils and reaches the contact thermometer almost immediately.

Most precision baths are not full-view because of lack of transparency of the insulating material. In the Steiner Constant Temperature Equipment the problem is solved by a double-walled container, with a vacuum between the walls. This container is built up from cylinders especially made and is protected against damage by cast metal flanges and bolts. If by accident one of the cylinders breaks the other will hold until a replacement arrives. The double-walled container is especially useful at low temperature, as no frost is formed and the container remains transparent. Instrument and apparatus which cannot be inserted in the bath can be connected by tubing to the pump, the output of which can be regulated.

Steiner Constant Temperature Equipment can be applied in connection with the measurement of many physical and chemical qualities, and is manufactured by the C. L. Burdick Manufacturing Co., of London, in two convenient sizes.

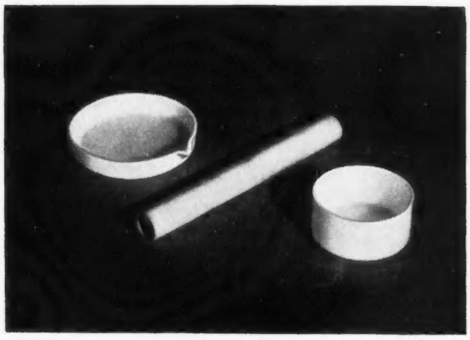
### Microchemical Apparatus

In the difficult conditions resulting from the war, Griffin and Tatlock, of London, report that production is being maintained and new instruments and apparatus are in constant process of development. Research and experiment are continuously in progress to discover new products and new methods of manufacture. Their results, in the development of new apparatus and methods, have repercussions in all industries where laboratory testing is carried on for the improvement of quality, purity and uniformity.

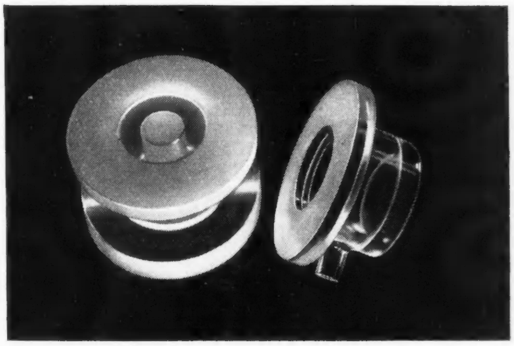
Microchemical methods probably signalise the most important advance made in chemical procedure within recent years. Chemists engaged in industrial and research laboratories are becoming increasingly aware of the value of such methods in saving in cost of reagents, materials and time, not to speak of their accuracy. The manipulative skill required, while greater than that for the corresponding macro methods, is not difficult to acquire and as soon as a sufficient number of workers is available micro methods will come into their own.

Essential oil determination apparatus has recently undergone improvement, mainly by the introduction of an entrainment distillation type, described in Report No. 1 of the Committees on Pharmaceutical Chemistry. Water, glycerine and water, or a mixture of isomeric xylenes is used as the distillation liquid. The apparatus may be used for drugs yielding an oil either heavier or lighter than water. Operation is rapid and results are more accurate than was possible with earlier types. Moisture determination apparatus has

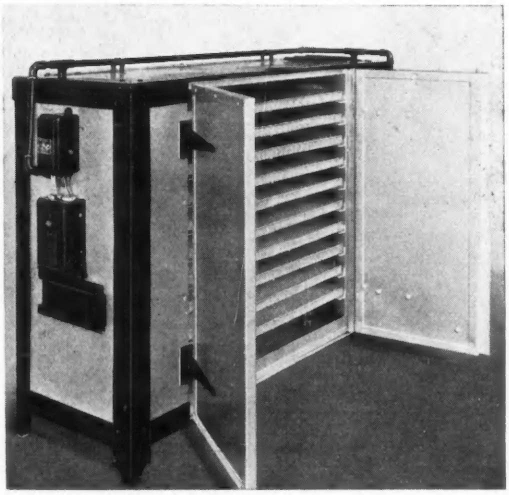
# SOME RECENT ADVANCES IN SCIENTIFIC APPLIANCES



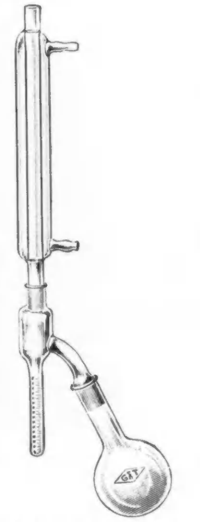
A group of Alumina laboratory ware manufactured by The Thermal Syndicate.



A pendulum case in transparent Vitreosil by The Thermal Syndicate.

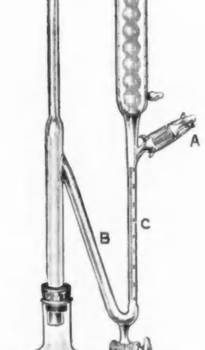


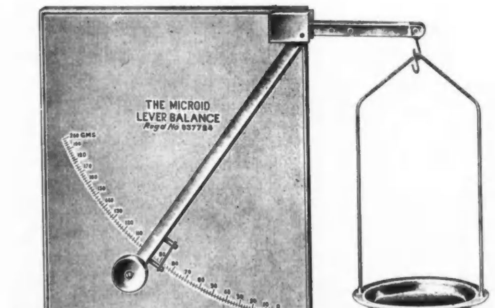
A small cabinet dryer for research laboratories supplied by L. A. Mitchell.

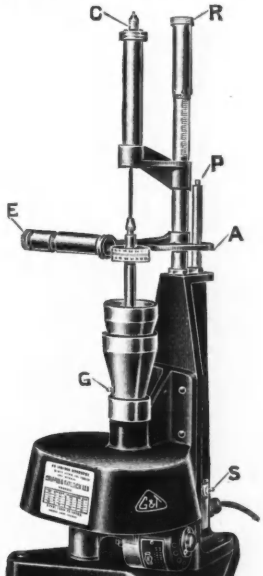


Moisture determination apparatus by Griffin & Tatlock.

The Steiner constant temperature equipment by C. L. Burdick.




Griffin & Tatlock are the manufacturers of these three appliances. From left to right: Essential oil determination apparatus; Microid lever balance; Goodeve thixoviscometer.

similarly been improved by the application of the entrainment distillation method in an apparatus worked out in the Government Laboratory, and recently standardised in B.S.S. 756-1939. The apparatus has been used with success in moisture determinations on materials as widely varied as cocoa, artificial silk yarn, and yeast. Ground-glass joints are employed throughout, and repetitive determinations with 99.5 per cent. precision on a 2 ml. volume of collected water are practicable.

Thixotropy is a physical condition of paste-like materials to which increasing attention is being given by food, paint, ink, glue, oil, bitumen, rubber, leather, gelatine, soap, and many other manufacturers. A substance is said to be thixotropic when increase of shear rate causes, at constant temperature, a reversible decrease in apparent viscosity, and it is this thixotropic, as opposed to the normal Newtonian, viscosity that renders many of the fluids involved in the above industries valuable from a commercial standpoint. The Goodeve Thixoviscometer is a new instrument designed to investigate this phenomenon on a quantitative basis. Its use has already resulted in a marked improvement in quality of many products in diverse trades, as a study of the thixotropic part of the viscosity very often provides additional information about such properties as stability, dispersion, and the presence of impurities.

## A New Balance

The Microid Lever Balance, which has just been introduced by Griffin and Tatlock, marks a great advance in speeding up the weighing of articles up to 200 grams. It is an automatic, self-indicating, oil-damped instrument, capable of indicating weight, within a limit of error of 0.5 gram, in less than six seconds. It may be used in either the laboratory or works and is quite inexpensive. The beam is mounted in a box-type bearing with a single hardened steel pivot upon which the system swings. To one end of the beam is fitted a strip pointer designed to eliminate parallax and to ensure accurate reading. This end of the beam also carries a counterweight. The other end of the beam is fitted with a hardened steel pivot supporting the double-hooked stirrup from which the bows, and a pan about 4 in. diam., depend. From the short arm of the lever a link is connected to a rod fitted with a vane moving in oil in a dashpot mounted at the rear of the balance. The dashpot is so arranged that it can be sealed to prevent oil leakage in transit.

A convenient and newly-developed accessory for research laboratories and the small-scale manufacture of new products is the small Cabinet Dryer supplied by L. A. Mitchell, of Manchester, which finds a wide and useful application in the chemical and allied industries. These drying cabinets are compact and self-contained units arranged for operating on the well-approved Mitchell drying system for obtaining rapid drying with maximum economy. The cabinets, as shown in the illustration, can be supplied either for steam or electric heating according to requirements and the nature of the product handled, and are arranged so that the drying temperature can be controlled. These units have proved of considerable benefit to works developing new processes, as the drying of new products can be carried out on a small scale, in secrecy and under normal works conditions. Further, many research departments, universities and technical departments have found such a cabinet of useful service, as the range of products which can be dried is very wide.

## Electrochemical Analysis

Apparatus for the rapid chemical analysis of solutions by electrochemical methods has been developed by Cambridge Instrument. Most metals and many acid radicals can be determined both qualitatively and quantitatively. The amount of material required is very small and the test can be repeated many times using the same solution which remains practically unaffected. This " polarograph " depends in principle upon the method developed by Heyrovsky and his co-workers, and can be used for such purposes as the determination of small traces of copper in aluminium alloys, measurement of traces of impurities such as copper in citric acid, analysis of sugars (especially the determination of fructose in glucose or sucrose), water analysis (especially dissolved oxygen, nitrates and colloids in natural waters), or the determination of alkali in ceramic materials, but there are numerous other uses in dyeing and bleaching, soap manufacture, making of alcoholic liquids, explosives, etc. The apparatus can be used for the qualitative detection of metal ions without calibration, but when used quantitatively it must be calibrated with known solutions of the metals to be determined. Whilst industrial needs have been kept in mind in designing the instrument, its utility for research purposes has not been overlooked. In operation a stream of mercury drops is allowed to fall from a jet immersed in the solution into a pool of mercury, the resulting current being measured when a variable voltage is applied between these mercury electrodes. The resulting voltage-current curve of the solution generally shows a number of " steps," and from the position of these on the voltage scale the nature of the ions present in the solution can be determined. From the height of the " step," by calibration under constant working conditions, it is possible to measure the concentration of the ions.

The design of their automatic water stills has been further improved by J. W. Towers and Co., of Widnes. These are produced in six sizes and may be obtained either in stainless steel or in copper. Heating is provided by gas, electricity, or steam. The gas-heated stills are fitted with an iron stand and gas burner, and chromium-plated tap; the electric models have a tinned copper base to the boiler for quick heat transfer, and spare heating elements are available. A chromium-plated copper steam coil with chromium-plated unions is a feature of the steam-heated stills.


**The Cambridge Polarograph.**


**Patent stainless steel still, electrically heated, by J. W. Towers.**

# NEW DEVELOPMENTS IN LABORATORY EQUIPMENT

## British Material Now Available

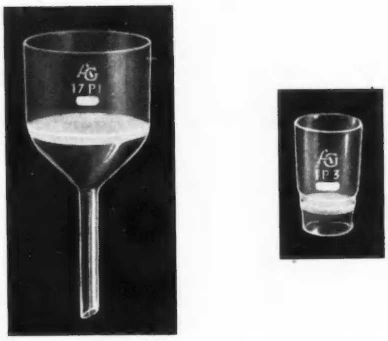
**by W. H. EDWARDS**

NOW that modern manufacturing methods require complete scientific control at all stages, it is important that the best possible equipment available should be obtained to secure the most reliable and accurate results, in as short a time as possible.

Much progress has been made by this country in recent years in the design and manufacture of laboratory apparatus which until recently could only be supplied from abroad; but with the increased demand it now is possible to obtain well designed and finished goods of British manufacture at reasonable prices, of which the following are examples.

Sintered glassware, for filtration, gas distribution, etc., such as Büchner funnels, Gooch crucibles, gas wash bottles, etc., are now available in porosities corresponding to the original foreign standards.

Recent flotation research indicates that any two substances, physically different but associated, can be separated by flotation under proper conditions, and the S.P. flotation apparatus has been designed for obtaining reliable flotation results



**Büchner funnel and Gooch crucible in British-made sintered glass.**

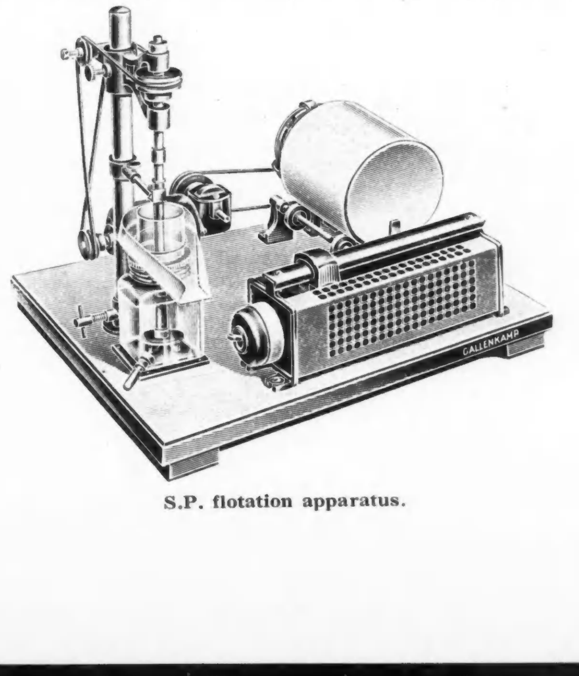
from ore quantities of 50 to 100 gm. and for ready portability. The flotation cell is of glass, which enables the operations of mixing, conditioning, froth formation, and removal to be observed. Close control of these steps is afforded by the rheostat that governs the rotational speed of the impeller. The construction of the cell permits it to be taken down and reassembled in a few minutes. A small pebble mill mounted on the same baseboard provides for a preliminary wet grinding stage in ore preparation, and for "mill-conditioning" when desired. The motor supplied runs off ordinary A.C. or D.C. mains of 200-250 volts and 50 cycles.

Another useful apparatus is the Tensile Strength Testing Machine for breaking strengths up to 2400 gm., and elongation up to 100 per cent. Originally designed for use in testing the tensile strength and elongation of paint, varnish and films, it has also been found useful in determining the tensile strength of other materials up to .002 in. thickness, and for various types of wrapping paper not exceeding .0025 in. thickness, and other similar materials. The machine is extremely simple in its operation. The test piece, secured in the clamps of the machine, is slowly stretched to its breaking point by mechanical elevation of the upper grip, the load in grams being automatically checked at the breaking point of the specimen and read from an indicator attached to the lower clamp. A device is also provided by which the amount of elongation of the specimen may be recorded. When this is desired, the specimen is marked with a special marker giving two lines, the distance between which is equal to 0-100 on the elongation scale. On setting the specimen in the machine the lines are brought up to coincide with the indicator of the elongation scale which has been previously set at zero. At the breaking point the points are re-set to coincide with the lines on the specimen and the amount of elongation is shown in percentage on the scale. The machine is geared internally and can be driven easily by means of a 1/100 h.p. electric motor.

**Tensile Strength Testing Machine.**

Until recently hydraulic pressing tests were only carried out with makeshift apparatus under difficult conditions. Tests carried out on large industrial presses are costly and generally necessitate special fittings. A Universal Hydraulic Press, entirely British built, is now available. It is a self-contained unit and is built of steel and semi-steel throughout. It is equipped with a large accurate bronze case gauge which reads for total load as well as for hydraulic pressure and has a maximum hand which indicates the maximum pressure obtained. The usual working range is from 0 to 20,000 lb. of applied load.

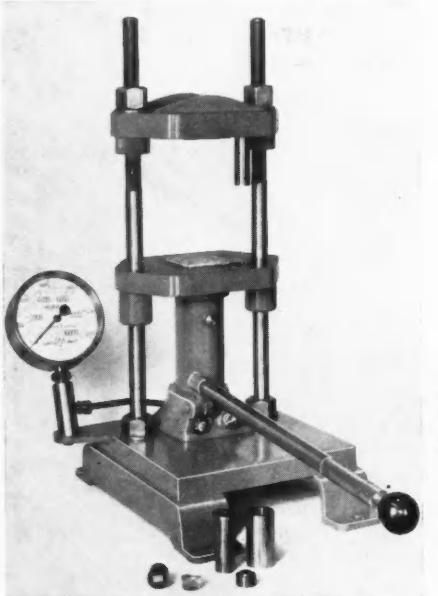
Special test equipment suitable for the tests required by various branches of the chemical industry is available; for crushing tests in the cement industry special swivel bearing plates are provided. For the pressing out of oils and liquids of various kinds a white nickel plate cage is provided. The cage equipment also serves for pressing liquid from fibrous materials, mother liquids from crystals and the expression of extracts. For softer materials plate and cloth equipment is



**S.P. flotation apparatus.**

provided by which the material to be pressed is enclosed in filter cloths.

For the rapid examination of samples of oil-bearing materials, oil seeds, etc., the press is of great use; samples of expressed oil for examination are obtained rapidly under conditions identical with production methods and the variations resulting from solvent extracted samples are avoided, the analyst obtaining rapid and truly representative analyses. For the operation test cylinder outfits complete with ejectors are provided. Hot plates, heated by either electricity or steam, are easily fitted to the press for carrying out this work. Special equipment for the expressible oil and moisture in

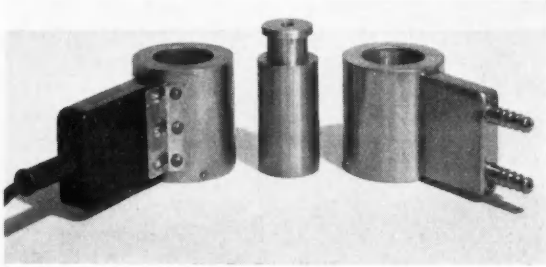


**The Universal Hydraulic Press, supplied by A. Gallenkamp & Co., and used for the mounting of metal specimens in Bakelite for micro-examination.**

waxes is available. For crushing tests on fragile articles, low range models fitted with test gauges of special accuracy are provided.

In the bakelite industry the press is usually equipped with electric hot plates suitable for heating to 400 deg. F., each fitted with thermometer pockets and asbestos insulation. Adjustable thermostatic control of the hot plates is now available. When steam hot plates are used the flexible hose connections are used also for water cooling. For small scale plastic moulding and control tests the equipment is of great use.

For the metallurgical industry a special model of the press is available for pressures up to five tons. This model is used *for the mounting of metal specimens in Bakelite for micro-examination.* Because of the absolute adherence of Bakelite to the metal the extreme edgs of specimens can be studied. It is used for the examination of plated sheets, ores and powders, and the use of Bakelite avoids the differential etch-



**Mould outfit and electric heaters used in the heat treatment of specimens mounted in the Universal Hydraulic Press.**

ing that occurs very frequently when fusible alloys are used for the mounting. The press is also used for the examination of plated materials, such as chromium plate.

Mounting of specimens takes about four minutes and the press is equipped with a positive ejector for easy removal of the mount from the mould. Mould outfits of hardened alloy steel are provided and electric heaters are used for the heat treatment. Water jacketed mould coolers are used to reduce the time of cooling and electric time switches can be provided to standardise the heating.

To ensure a slide legible to the audience, typewriter slides for lanterns are now obtainable. This useful little adjunct to one side of laboratory work consists of a cellophane film placed between red carbons, both of which are placed in a mount $3\frac{1}{4}$ in. by 3 in. Type in the centre space, remove the film from the carbons and insert between a pair of slides, which can be held together either by india-rubber rings or the usual binding strips.

# Combating Air-Borne Infection

## U.V. Irradiation from Discharge Tubes

THE problem of air-borne infection has for many years been engaging attention, and Professor W. F. Wells, an American scientist now working at Pennsylvania University (Laboratory for the Study of Air-Borne Infection), has made a particular study of this question. In testing different methods of eliminating air-borne bacteria, he found that the only method that gave successful results was irradiation of the air with short-wave ultra-violet rays, as generated by quartz mercury discharge tubes. A percentage of germs could be killed by other means, *e.g.,* by spraying disinfectants, but no other method was 100 per cent. effective, and all had drawbacks. Irradiating the air with ultra-violet rays, on the other hand, is found both to kill all germs within range and also to keep the air free of bacteria; this is essential, because in an occupied room fresh germs are constantly being spread by the inmates.

The new Sanitary Air Lamps are now installed in many hospitals, schools and public buildings. As made in this country by Hanovia, of Slough, the standard equipment is named the "Sanitizer Major." It comprises one of the special low-pressure mercury discharge tubes, 10 in. long, mounted across a horizontal drum-shaped spinning which narrows below to accommodate a transformer, motor-driven up-draught fan and impregnated filter. A single unit of this type will maintain the air free of germs for a radius up to 12 ft. all round. In a large room, a number of these units suspended just above head level, distributed like individual lighting fixtures so as to cover the space, will maintain the air free of germs. The ultra-violet rays act directly only above eye-level; the circulation of the air promoted by the fan is found to give good air sanitation below as well as above this level. Electrically, the Sanitizer Major is built to the high standard which is typical of Hanovia products. The 1/60 h.p. motor, giving 900 r.p.m. of the 4-bladed fan, is very silent and requires no attention. The impregnated filter gives practically everlasting service, requiring only a paraffin wash about twice a year. The ultra-violet ray tube operates at 400 volts with a 30 m.a. load, giving a total load of 45 watts for the unit. Small Rhodoid fluorescent panels in the side of the casing indicate when the unit is operating.

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ACCORDING TO "World Trade Notes" of the U.S. Department of Commerce, the latest complete caffeine synthesis to which attention is being devoted in Germany is based upon uric acid. In obtaining caffeine by this method the cost is said to be double that of extracting this alkaloid from tea leaves or coffee beans, and therefore it is practical only in emergencies such as exist at present.

# PERSONAL NOTES

MR. PATRICK R. E. PEEL, B.Sc., A.I.C., who until the outbreak of war was editor of THE CHEMICAL AGE and is now a 2nd lieutenant in the Royal Engineers, was married on April 20 to Miss Doreen M. Lewis, of Kingston-on-Thames.

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CAPTAIN A. HAYTON COWAP, president of the Teesside Chamber of Commerce, is leaving Teesside to take up a post at Liverpool with the Imperial Chemical Industries, Ltd. Captain Cowap is a delegate director of the fertiliser group of I.C.I.

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At the annual general meeting of the Association of Tar Distillers on April 16, the following officers were appointed for the ensuing year: President, MR. S. ROBINSON; vice-president, LT.-COM. C. BUIST; hon. treasurer, MR. C. E. CAREY; hon. auditor, MR. E. HARDMAN.

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MR. H. CALAM, who is to be the next president of the Nottingham City Business Club, is assistant manager of the chemical department of Boots Pure Drug Co., Ltd. He is chairman of the Nottingham section of the Society of Chemical Industry.

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MR. W. L. CLEMENT, general manager at the Shell Haven Works of the Shell Refinery and Marketing Co., has taken up an important appointment with the same company near Chester. Among the presentations made to him at his departure was a cheque for £40 10s., which Mr. Clement handed to the Red Cross Fund at the Shell Haven Works.

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PROFESSOR A. M. BRYAN, who has held the joint appointment of Professor of Mining in Glasgow University and in the Royal Technical College, Glasgow, since 1932, has intimated his intention to resign as from July 31, 1940, in order to take up an industrial appointment. The University Court has accepted his resignation.

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The committee of the Plastics Group of the Society of Chemical Industry has appointed the following officers for session 1940-1941: Chairman: MR. AUSTIN LOWE; vice-chairman: MR. C. CHAPMAN; hon. secretary: MR. N. J. L. MEGSON; hon. treasurer: MR. C. CHAPMAN; hon. recorder: DR. S. H. BELL. MR. C. DIAMOND and DR. G. S. WHITBY have been appointed to the committee.

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The following nominations have been made for the election of officers at the annual general meeting of the Electrodepositors' Technical Society at Birmingham on May 7: Chairman, MR. A. W. WALLBANK, B.Sc., A.I.C.; vice-chairman, MR. B. J. R. EVANS; hon. secretary, MR. G. A. DURRANCE; asst. hon. secretary, MR. H. F. BACHE; hon. treasurer, MR. H. F. J. STOKES.

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A gift of £250,000 has been made by MR. CHARLES RATCLIFFE BROTHERTON for the furtherance of education, medical and surgical research, and other charitable objects. Six towns in the Midlands and Northern England will benefit thereby. Mr. Brotherton, who is 58, is chairman of the chemical manufacturing firm of Brotherton and Co., Ltd., and the gift has been made to the towns in which his firm has branches—Leeds, Liverpool, Birmingham, York, Wakefield and Bebington. A trust yielding an annual income of £10,000 will be formed for welfare schemes, and articles of the trust deed provide that in times of national emergency the money may be used to benefit national charities.

## OBITUARY

MR. EDWARD W. GREEN, who was in charge of the development of Tufnol bearings for Ellison Insulations, Ltd., died recently aged 40.

MR. FRANCIS HAROLD SMITH, whose death was recently reported, was a director of the Trinity Dye Works at Hinckley, Leics.

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MR. WILFRID E. BIDDLE, a partner in the firm of Ralph Nye, Biddle and Co., colours and chemicals, Boston House, New Broad Street, London, E.C.2, died recently, aged 44.

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MR. JOHN AULD, of David Auld and Sons, Ltd., valve manufacturers, Whitevale Foundry, Glasgow, died recently at Bridge of Allan.

# Chemical Matters in Parliament

### I.C.I. (India) Ltd.

IN the House of Commons last week, Mr. Gallacher asked the Under-Secretary of State for India what concessions had been granted by the Government of India to Imperial Chemical Industries (India) in the Punjab or other parts of India; and for how long, and under what conditions?

Sir H. O'Neill, replying, said he understood that certain concessions were granted to Imperial Chemical Industries (India), Ltd., to assist them in establishing an alkali factory near Khewra in the Punjab. These related to the use of waste salt, salty material, marl and brie·at Khewra and in a neighbouring area. The period of the concessions was 50 years. So far as the Central Government was concerned he was not aware of anything else.

### Stoppage at Chemical Factory

Also last week in the Commons Mr. Marshall asked the Minister of Labour whether he was aware that a stoppage of work was caused at a chemical factory in Scotland owing to the introduction by his department of labour from Belfast at a time when the regular workmen were on short time; that the Belfast men were building-trade and civil-engineering workmen with no previous experience of chemical works; and that it was proposed to include them among the piecework squads and thereby reduce the earnings of the regular pieceworkers; and would he cause inquiries to be made with the object of avoiding a recurrence of similar trouble.

Mr. E. Brown replied that he understood that the firm in question recently notified vacancies to the Employment Exchange for 20 heavy labourers for pick, shovel and barrow work, and that as suitable applicants were not available locally or in other parts of Scotland nine applicants from Northern Ireland were submitted. It appeared that in notifying those vacancies the firm anticipated a need for extra labour which had not in fact arisen by the time that the additional workers arrived. There was a stoppage of work among the firm's regular workmen which lasted one day and was ended when it was known that the additional men were not to be started.

### Site of Chemical Works

Major Procter asked the Minister of Supply whether his attention had been drawn to the proposal to erect a chemical works in the Ribble Valley, which was one of the beauty spots of Lancashire; and whether he would take steps to prevent this.

Colonel Llewellin: The answer to the first part of the question is in the affirmative; the answer to the second part is that the site for the proposed factory is still under consideration.

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THE RATE OF OXIDATION of camphene to camphor is considerably increased in presence of certain activating agents. When using an oxidising mixture of 8 parts potassium chromate, 22.5 parts sulphuric acid and 69.5 parts water, the maximum activation was secured with nitric acid (resulting from oxidation of nitrous acid *in situ*). Yield and quality of the camphor are not affected . . . Davankov and Berlin, J. App. Chem. (U.S.S.R.), 1939, 1406.

# General News—From Week to Week

A FACTORY HAS BEEN OPENED at Hatton, near Burton-on-Trent, for the processing of flax, and the Ministry of Supply has undertaken to purchase the output of at least 400 acres.

POLYMERISATION OF VINYL COMPOUNDS in non-aqueous media is readily effected with peracetic anhydride which is claimed to be superior as a catalyst to benzoyl peroxide (F.P. 854,115).

THE PRODUCT OF DIRECT NITRATION of phenyl dinitromethane is meta-nitrophenyl dinitromethane, a powerful explosive which is the subject of a recent study by Milone and Massa (La Chimica e L'Industria, March, 1940, p. 141).

THREE THOUSAND WORKERS in the Scottish tube manufacturing industry are to receive an advance in wages. Men will receive a rise of 4s. per week, youths between 18 and 21, 2s. 6d., and boys under 18 1s. 6d. The increases are to take effect as from April 1.

FOUR MEN WERE KILLED and about twenty injured by an explosion and fire at the Imperial Chemical Industries' works at Billingham-on-Tees, Durham, on Wednesday. The explosion took place in the coal-grinding plant of the boiler-house. The damage to plant and machinery was slight.

ACCORDING TO THE Board of Trade returns for the month ended March 31 imports of chemicals, drugs, dyes and colours into the United Kingdom were valued at £1,947,771, an increase of £560,041 as compared with March, 1939. Exports were valued at £2,804,438, an increase of £697,615. Re-exports were valued at £55,504.

A. ELDER REED AND CO., LTD., import and export merchants, transferred their offices this week from 28 Monument Street, London, E.C.3, and from Pinner and Sutton to new warehouse and offices at 105 Battersea High Street, London, S.W.11. All communications should be sent to the new address, the telephone number of which is Battersea 8401/2.

THE BRITISH DYESTUFFS CORPORATION, LTD., will in future be known as I.C.I. (Dyestuffs), Ltd.; Nobel Chemical Finishes, Ltd., as I.C.I. (Paints), Ltd.; and the Salt Union as I.C.I. (Salt), Ltd. This designation will bring these three associated companies into line with the other manufacturing groups of Imperial Chemical Industries, Ltd.

THE NEW YORK "CERAMIC AGE" in its Toronto Convention Number (April, 1940) incorporates an attractive coloured four-page advertisement of the Paper Makers Importing Co., Inc., the main feature of which is a series of photographs illustrating the Cornish china-clay industry. A short historical and technical account of the industry is likewise included.

ANTI-MISTING PASTES FOR WINDSCREENS and the like consist of 60-80 per cent. sulphonated fatty alcohol (lauryl or cetyl sulphonic acid) and 10-20 per cent. polyhydric alcohol (glycerine, diethylene glycol, etc.) to which may be added a small percentage of an organic soap such as triethanolamine stearate (F.P. 854,200). This type of composition is on rather different lines from the anti-misting solution specified by the Air Ministry in this country (D.T.D. 338).

"THE BRITISH TRADE JOURNAL AND EXPORT WORLD," now in its 78th year of publication, announces that it has completed plans for an important new departure. It will include in its pages every other month, beginning with the July issue, a special supplement in the Turkish language. The recently signed Anglo-Turkish Trade Agreement gives to British manufacturers far more favourable opportunities in the great Turkish market than they have ever enjoyed before. The new supplement, fully documented both on the editorial and advertisement sides, will be brought to the attention of every buyer of standing throughout the Turkish dominions at a time when his practical interest has been keenly aroused in news of British goods and methods of trading with this country.

## Foreign News

UNDER A NEW DECREE of the Chilean Government, all patent and other medicines manufactured in Chile must bear a label to this effect, while drugs imported from abroad and packed in Chile must also convey this fact on their packing. Medicines imported from abroad must be provided with a separate label bearing the one word: "Importado."

NICKEL PRODUCERS IN ONTARIO have completed arrangements whereby matte obtained in an operation formerly utilising refining facilities in Norway, will now obtain the same facilities from the chief Canadian nickel company.

BY A DECREE PUBLISHED in the *Journal Officiel* of April 5, the declaration of all tanning materials and products held by firms or individuals in France is made obligatory. Regulations as to the nature of the products concerned and conditions of declaration are published in the same issue of the *Journal*.

THE BOARD OF THE ALMADEN MINES will now authorise licences for the export of Spanish mercury, formerly granted by the Government's Executive Committee for Foreign Trade. The Spanish Ministry of Finance published a notification on April 9 to this effect.

A NEW ORGANISATION, Föreningen Bilkol, has been set up in Sweden to organise charcoal production and distribution for motoring purposes. It is understood that the organisation will receive a subsidy from the government in the form of a loan of 500,000 kr. to produce and store for emergency purposes some 150,000 hectolitres of charcoal for producer-gas plants. The sale price of this charcoal will be from 3¾ to 4 kr. per hectolitre, delivered to customers in kraft paper bags.

LICENCES HAVE BEEN ISSUED by the Italian Government to the S.A. Industria Italiana Amidi Glucosio Affini, of Milan, for the erection of a plant at Milan for the production of starch, glucose and dextrine, to the Soc. Nazionale Industrie Tanniche (S.N.I.T.) of Carasco (Genoa) for the erection of a plant at Carasco for the production of starch, and to the Consorzio Amiderie Riunite Fratelli Ambiveri e Zibetti e Cia., of Caravaggio (Bergamo), for the erection of a division in its starch factory at Caravaggio for the production of glucose.

THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH in Australia will shortly publish a full account of a new and relatively simple process for rendering wool "unshrinkable." This is the outcome of an investigation carried out by Mr. M. R. Freney, B.Sc., and Mr. M. Lipson, B.Sc., of the Council's McMaster Laboratory in Sydney, who have discovered that certain concentrations of alkali, when properly applied, will reduce the capacity of wool to shrink and felt. The results they have obtained compare favourably with those given by the processes which have already come into commercial use. The new process has the great advantage of simplicity. The wool can be treated in top form by passing the sliver through a bath of alkali, then through rollers into a bath of acid, and finally through a water wash. The "Industrial Australian and Mining Standard" reports that the process is undergoing a thorough test under factory conditions at a well-known woollen mill in Sydney, where over a ton of wool has now been treated.

## Forthcoming Events

A MEETING OF THE Electrodepositors' Technical Society will be held on April 29, at the Northampton Polytechnic Institute, at 7.15 p.m. Papers will be presented on "Developments in connection with the Bullard-Dunn Pickling Process," by J. Kronshein, D.Sc., and on "The Technique of Filtering Nickel Plating Solutions," by S. Wernick, M.Sc., Ph.D., and H. Silman, B.Sc., A.I.C.

AN EXTRA MEETING OF THE LONDON SECTION, Society of Chemical Industry, will be held at West Ham Municipal College, Romford Road, Stratford, London, E., on April 30, at 5.30 p.m., when a paper will be presented by Dr. O. Bloch, (of Ilford, Ltd.), on "The Photographic Emulsion and a Few of Its Applications."

AN ORDINARY MEETING of the Institution of Chemical Engineers will be held on May 7 in the Rooms of the Geological Society, Burlington House, London, W.1, at 5.15 p.m. A paper on "Measurement of the Flow of Liquids and Gases" will be presented by E. Ower, B.Sc., F.R.Ae.S., of the National Physical Laboratory.

THE NEXT MEETING IN BIRMINGHAM of the Electrodepositors' Technical Society will be held on May 7, at the James Watt Memorial Institute, Great Charles Street, Birmingham, when a paper will be presented entitled "Some Aspects of Throwing Power," by L. Wright, B.Sc.